APPROPRIATE APPLICATION OF SEDIMENT QUALITY GUIDELINES

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SEDIMENT QUALITY GUIDELINES (SQG)

"Numerical chemical concentrations intended to be either protective of biological resources, or predictive of adverse effects to those resources, or both." (Pellston Workshop, 17-22 August 2002)

- **Mechanistically derived:** theoretical understanding of factors that govern bioavailability and known relationships between chemical exposure and toxicity (EqP theory)
- **Empirically derived:** sediment chemistry and observed biological effects (from toxicity tests and benthic community information)

MECHANISTICALLY DERIVED METHODS

- **Equilibrium Partitioning (EqP):** sediment:water partitioning of organics to predict concentrations above which effects are expected, based on surface water quality criteria
- **Simultaneously Extracted Metals/Acid Volatile Sulfides (SEM/AVS):** sediment:water partitioning of metals (Cd, Cu, Hg, Ni, Pb, and Zn) to predict concentrations below which effects are not expected

EMPIRICALLY DERIVED METHODS

- **Apparent Effects Threshold (AET):** sediment contaminant concentration above which the biological response of concern was always observed in the data set from which the values were derived
- **Effects Range Low/Effects Range Median (ERL/ERM):** statistical analysis of sediment chemical concentrations with biological responses using only “effect” data
- **Threshold Effects Level/Probable Effects Level (TEL/PEL):** statistical analysis of sediment chemical concentrations with biological responses using “effect” and “no effect” data

LIMITATIONS OF SQGs

- SQGs developed for one environment have no relevance for other environments.
- Inability to predict presence or absence of chronic toxicity in field-collected sediments.
- Inability to predict bioaccumulation of sediment-associated contaminants.
- Inability to establish cause and effect relationships.
- Inability to predict effects on organisms exposed in field conditions.

LIMITATIONS OF SQGs

- Not all contaminants have values
- Do not address chemical interactions (synergism, antagonism)
- Reliability of EqP and SEM/AVS has not been quantified
- High false negative and false positive rates:
  - ~10% probability of toxicity when below all ERLs (Long et al. 1998)
  - Of 239 samples that exceeded at least one ERM, only 38% were toxic to amphipods (O'Connor et al. 1998)

APPROPRIATE APPLICATION OF SQG VALUES

- Determine that a sediment is not likely to cause effects to benthos
- Identify the need for additional evaluations
- Help focus the scope of additional study (e.g., reduce number of COCs, pathways or receptors to be considered in baseline assessment)
- May be used in a WOE approach with other data (benthic toxicity, biological indices, tissue residues, effects data)

SECONDARY SEDIMENT/SITE ASSESSMENT

- Defining assessment and measurement endpoints
- Selecting LOE within 3 general categories
  - Direct exposure or effects in the water column
  - Direct exposure or effects to the benthos
  - Indirect exposure and effects through contaminant trophic transfer
- Selecting and applying assessment tools within the chosen LOE
- Analyzing the collected information to reach conclusion based on a WOE approach
- Revising the conceptual model to identify remaining data gaps

KEY LINES OF EVIDENCE

- Sediment contaminant chemistry and geochemical characteristics
- Benthic invertebrate community structure
- Sediment toxicity testing (chronic and/or acute)
- Bioaccumulation and biomagnification data

DEFINING WOE

- **WOE required for decision-making should be established based on:**
  - **Pathways by which risks might exist**
  - **Receptors for those risks**
  - **Spatial extent of the contamination**
  - **Regulatory goals**
  - **Long-term costs of different management decisions**

ESTABLISHING CAUSALITY

- Diagnostic protocols and weighing the strength of evidence (multistep process) via 7 causal considerations:
  - Co-occurrence (spatial correlation)
  - Temporality (temporal correlation)
  - Magnitude of effect (strength of link)
  - Consistency of association (at multiple sites)
  - Experimental confirmation (field or lab)
  - Plausibility (likelihood of stressor-effect linkage)
  - Specificity (stressor causes unique effect)

SQG "DO'S AND DONT'S"

- **SQGs DO:**
  - Have large false negative and false positive error rates
  - Help determine the need for additional evaluation of the likelihood for effects
  - Help focus the scope of additional studies
- **SQGs DO NOT:**
  - Consider chemical interactions
  - Consider all potential pathways
  - Provide quantitative estimates of risk
  - Provide suitable remedial targets or cleanup levels

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